THE PENDING CLAIMS:

1. (Previously Presented) A method for forming a ruthenium layer on a substrate, comprising:

positioning a substrate within a process chamber; and

exposing the substrate sequentially to a ruthenium-containing compound and a reducing gas during an atomic layer deposition process to form a ruthenium material on the substrate, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, (2,4-dimethylpentadienyl) ruthenium (cyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (methylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (ethylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (isopropylcyclopentadienyl), derivatives thereof, and combinations thereof.

2. (Previously Presented) The method of claim 1, wherein the process chamber is purged with a purge gas and a deposition cycle of the atomic layer deposition process includes sequentially delivering the ruthenium-containing compound, the purge gas, the reducing gas and the purge gas into the process chamber.

3. (Cancelled)

4. (Previously Presented) The method of claim 1, wherein the reducing gas comprises one or more gases selected from the group consisting of hydrogen, atomic hydrogen, ammonia, silane, disilane, dimethylsilane, methylsilane, ethylsilane, chlorosilane, dichlorosilane, hexachlorodisilane, borane, diborane, triborane, tetraborane, pentaborane, triethylborane, derivatives thereof, and combinations thereof.

5. (Previously Presented) The method of claim 4, wherein the substrate is heated to a temperature below about 400°C and the process chamber is pressurized to a pressure below about 80 Torr.

6. (Cancelled)

7. (Original) The method of claim 2, wherein the purge gas is selected from the group consisting of helium, argon, hydrogen, nitrogen, and combinations thereof.

8. (Previously Presented) The method of claim 5, wherein the ruthenium-containing compound is pulsed into the process chamber for a duration within a range from about 0.05 seconds to about 1.5 seconds.

9. (Previously Presented) The method of claim 8, wherein the reducing gas is pulsed into the process chamber for a duration within a range from about 0.1 seconds to about 2 seconds.

10. (Previously Presented) The method of claim 7, wherein the purge gas is pulsed into the process chamber for a duration within a range from about 0.07 seconds to about 1 second.

11. (Previously Presented) The method of claim 4, wherein the ruthenium material is formed having a thickness within a range from about 10 Å to about 100 Å.

12. (Cancelled)

13. (Previously Presented) The method of claim 1, wherein the ruthenium-containing compound is exposed to the substrate from an expanding channel.

14. (Previously Presented) A method for forming a ruthenium layer on a substrate, comprising:

positioning a substrate within a process chamber;

exposing the substrate to a carrier gas having a circular flow pattern; and

exposing the substrate sequentially to a ruthenium-containing compound to form a ruthenium material on the substrate, wherein the ruthenium-containing compound and

the reducing gas are sequentially pulsed into the carrier gas and the ruthenium-containing compound contains a 2,4-dimethylpentadienyl ligand.

15. (Cancelled)

16. (Previously Presented) The method of claim 14, wherein the ruthenium-containing compound is selected from the group consisting of
bis(2,4-dimethylpentadienyl) ruthenium,
(2,4-dimethylpentadienyl) ruthenium (cyclopentadienyl),
(2,4-dimethylpentadienyl) ruthenium (methylcyclopentadienyl),
(2,4-dimethylpentadienyl) ruthenium (ethylcyclopentadienyl),
(2,4-dimethylpentadienyl) ruthenium (isopropylcyclopentadienyl), derivatives thereof, and combinations thereof.

17. (Previously Presented) The method of claim 16, wherein the reducing gas comprises one or more gases selected from the group consisting of hydrogen, atomic hydrogen, ammonia, silane, disilane, dimethylsilane, methylsilane, ethylsilane, chlorosilane, dichlorosilane, hexachlorodisilane, borane, diborane, triborane, tetraborane, pentaborane, triethylborane, derivatives thereof, and combinations thereof.

18. (Previously Presented) The method of claim 17, wherein the substrate is heated to a temperature below about 400°C and the process chamber is pressurized to a pressure below about 80 Torr.

19. (Cancelled)

20. (Previously Presented) The method of claim 14, wherein the carrier gas is selected from the group consisting of helium, argon, hydrogen, nitrogen, and combinations thereof.

21. (Previously Presented) The method of claim 18, wherein the ruthenium-containing compound is pulsed into the carrier gas for a duration within a range from about 0.05 seconds to about 1.5 seconds.

22. (Previously Presented) The method of claim 21, wherein the reducing gas is pulsed into the carrier gas for a duration within a range from about 0.1 seconds to about 2 seconds.

23. (Cancelled)

24. (Previously Presented) The method of claim 17, wherein the ruthenium material is formed having a thickness within a range from about 10 Å to about 100 Å.

25-26. (Cancelled)

27. (Previously Presented) A method for forming a layer comprising ruthenium on a substrate within a process chamber, comprising:

a) exposing a substrate to a ruthenium-containing compound to form a ruthenium-containing layer thereon, wherein the ruthenium-containing compound contains a 2,4-dimethylpentadienyl ligand;

b) purging the process chamber with a purge gas;

c) exposing the substrate to a reducing gas to form a ruthenium-containing layer material thereon; and

d) purging the process chamber with the purge gas.

28. (Previously Presented) The method of claim 27, wherein the ruthenium material is formed by repeating an ALD process cycle of steps a-d.

29. (Previously Presented) The method of claim 28, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium,

(2,4-dimethylpentadienyl) ruthenium (cyclopentadienyl),
(2,4-dimethylpentadienyl) ruthenium (methylcyclopentadienyl),
(2,4-dimethylpentadienyl) ruthenium (ethylcyclopentadienyl),
(2,4-dimethylpentadienyl) ruthenium (isopropylcyclopentadienyl), derivatives thereof, and combinations thereof.

30. (Previously Presented) The method of claim 29, wherein the reducing gas comprises one or more gases selected from the group consisting of hydrogen, atomic hydrogen, ammonia, silane, disilane, dimethylsilane, methylsilane, ethylsilane, chlorosilane, dichlorosilane, hexachlorodisilane, borane, diborane, triborane, tetraborane, pentaborane, triethylborane, derivatives thereof, and combinations thereof.

31. (Previously Presented) The method of claim 30 wherein the substrate is heated to a temperature below about 400°C and the process chamber is pressurized to a pressure below about 80 Torr.

32. (Cancelled)

33. (Original) The method of claim 28, wherein the purge gas is selected from the group consisting of helium, argon, hydrogen, nitrogen, and combinations thereof.

34. (Previously Presented) The method of claim 31, wherein the ruthenium-containing compound is pulsed into the process chamber for a duration within a range from about 0.05 seconds to about 1.5 seconds.

35. (Previously Presented) The method of claim 34, wherein the reducing gas is pulsed into the process chamber for a duration within a range from about 0.1 seconds to about 2 seconds.

36. (Previously Presented) The method of claim 33, wherein the purge gas is pulsed into the process chamber for a duration within a range from about 0.07 seconds to about 1 second.

37. (Previously Presented) The method of claim 30, wherein steps a-d are repeated to form [[s]] the ruthenium material having a thickness within a range from about 10 Å to about 100 Å.

38-52. (Cancelled)

53. (Previously Presented) The method of claim 13, wherein the expanding channel is positioned to expose the substrate to a carrier gas.

54. (Previously Presented) The method of claim 53, wherein the carrier gas is delivered from the expanding channel having a circular flow pattern.

55. (Previously Presented) The method of claim 54, wherein a deposition cycle of the atomic layer deposition process includes sequentially delivering the ruthenium-containing compound and the reducing gas into the carrier gas.

56. (Previously Presented) The method of claim 55, wherein the reducing gas contains a member selected from the group consisting of hydrogen, atomic hydrogen, ammonia, derivatives thereof, and combinations thereof.

57. (Previously Presented) The method of claim 56, wherein the carrier gas contains a gas selected from the group consisting of hydrogen, nitrogen, argon, helium, and combinations thereof.

58. (Previously Presented) The method of claim 54, wherein the circular flow pattern is selected from the group consisting of a vortex pattern, a helix pattern, a spiral pattern, a derivative thereof, and a combination thereof.

59. (Previously Presented) The method of claim 14, wherein the circular flow pattern is formed as the carrier gas passes through an expanding channel positioned within the process chamber.

60. (Previously Presented) The method of claim 59, wherein the reducing gas contains a member selected from the group consisting of hydrogen, atomic hydrogen, ammonia, derivatives thereof, and combinations thereof.

61. (Previously Presented) The method of claim 59, wherein the circular flow pattern is selected from the group consisting of a vortex pattern, a helix pattern, a spiral pattern, a derivative thereof, and a combination thereof.

62. (Previously Presented) The method of claim 27, wherein the process chamber contains an expanding channel positioned to expose the substrate to a carrier gas.

63. (Previously Presented) The method of claim 62, wherein the carrier gas is delivered from the expanding channel having a circular flow pattern.

64. (Previously Presented) The method of claim 63, wherein the ruthenium-containing compound is pulsed into the carrier gas.

65. (Previously Presented) The method of claim 64, wherein the purge gas is the carrier gas.

66. (Previously Presented) The method of claim 65, wherein the reducing gas contains a member selected from the group consisting of hydrogen, atomic hydrogen, ammonia, derivatives thereof, and combinations thereof.

67. (Previously Presented) The method of claim 65, wherein the carrier gas contains a gas selected from the group consisting of hydrogen, nitrogen, argon, helium, and combinations thereof.

68. (Previously Presented) The method of claim 67, wherein the circular flow pattern is selected from the group consisting of a vortex pattern, a helix pattern, a spiral pattern, a derivative thereof, and a combination thereof.

69. (Previously Presented) A method for forming a ruthenium layer on a substrate, comprising:

positioning a substrate on a substrate support within a process chamber;

flowing a carrier gas through an expanding channel substantially axially positioned with the substrate, wherein the carrier gas forms a circular flow pattern along the expanding channel; and

exposing the substrate to the carrier gas while pulsing a ruthenium-containing compound into the carrier gas to form a ruthenium material on the substrate.

70. (Previously Presented) The method of claim 69, wherein the carrier gas contains a gas selected from the group consisting of hydrogen, nitrogen, argon, helium, and combinations thereof.

71. (Previously Presented) The method of claim 70, wherein the circular flow pattern is selected from the group consisting of a vortex pattern, a helix pattern, a spiral pattern, a derivative thereof, and a combination thereof.

72. (Previously Presented) The method of claim 69, wherein a reducing gas and the ruthenium-containing compound are sequentially pulsed into the carrier gas and the reducing gas contains a member selected from the group consisting of hydrogen, atomic hydrogen, ammonia, silane, disilane, diborane, derivatives thereof, and combinations thereof.

73. (Previously Presented) The method of claim 69, wherein the ruthenium-containing compound and a reducing gas are sequentially pulsed into the carrier gas and the ruthenium-containing compound contains a 2,4-dimethylpentadienyl ligand.

74. (Previously Presented) The method of claim 73, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, (2,4-dimethylpentadienyl) ruthenium (cyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (methylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (ethylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (isopropylcyclopentadienyl), derivatives thereof, and combinations thereof.

75. (Previously Presented) The method of claim 69, wherein the ruthenium-containing compound is selected from the group consisting of tris(2,2,6,6-tetramethyl-3,5-heptanedionato) ruthenium, bis(2,4-dimethylpentadienyl) ruthenium, dicarbonyl pentadienyl ruthenium, ruthenium acetyl acetonate, (2,4-dimethylpentadienyl) ruthenium (cyclopentadienyl), bis(2,2,6,6-tetramethyl-3,5-heptanedionato) ruthenium (1,5-cyclooctadiene), (2,4-dimethylpentadienyl) ruthenium (methylcyclopentadienyl), (1,5-cyclooctadiene) ruthenium (cyclopentadienyl), (1,5-cyclooctadiene) ruthenium (methylcyclopentadienyl), (1,5-cyclooctadiene) ruthenium (ethylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (ethylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (isopropylcyclopentadienyl), bis(N,N-dimethyl 1,3-tetramethyl diiminato) ruthenium (1,5-cyclooctadiene), bis(N,N-dimethyl 1,3-dimethyl diiminato) ruthenium (1,5-cyclooctadiene), bis(allyl) ruthenium (1,5-cyclooctadiene), (η^6-C_6H_6) ruthenium (1,3-cyclohexadiene), bis(1,1-dimethyl-2-aminoethoxylato) ruthenium (1,5-cyclooctadiene), bis(1,1-dimethyl-2-aminoethylaminato) ruthenium (1,5-cyclooctadiene), derivatives thereof, and combinations thereof.